MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

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EVOLUTIONARY SPACE PLATFORM CONCEPT STUDY
VOLUME III – PROGRAMMATICS FOR MANNED SPACE PLATFORM CONCEPTS

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PREFACE

This document (Volume III, Programmatics) contains material prepared by McDonnell Douglas Astronautics Company in a study of the "Characterization of an Evolutionary Science and Applications Space Platform," as defined in the Statement of Work for Contract NAS8-33592 by NASA/George C. Marshall Space Flight Center, where the contact is:

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NOTE: This document is one of a series which also contains Volume I, Executive Summary and Volume II, Technical.

FOREWORD

The Evolutionary Space Platform Concept Study encompassed a 10-month effort to define, evaluate and compare approaches and concepts for evolving unmanned and manned capability platforms beyond the current Space Platform concepts to an evolutionary goal of establishing a permanent-manned presence in space.

The study included three parts:

- Part A - Special emphasis trade studies on the current unmanned SASP concept ($50,000)
- Part B - Assessment of manned platform concepts ($250,000)
- Part C - Utility analysis of a manned space platform for defense-related missions ($140,000)

In Part A, special emphasis trade studies were performed on several design and operational issues which surfaced during the previous SASP Conceptual Design Study (reference: MDC G9246, October 1980) and required additional studies to validate the suggested approach for an evolution of an unmanned platform. Studies conducted included innovative basic concepts, image motion compensation study and platform dynamic analysis.

The major emphasis of the study was in Part B, which investigated and assessed logical, cost-effective steps in the evolution of manned space platforms. Tasks included the analysis of requirements for a manned space platform, identifying alternative concepts, performing system analysis and definition of the concepts, comparing the concepts and performing programmatic analysis for a reference concept.

The Part C study, sponsored by the Air Force Space Division (AFSD), determined the utility of a manned space platform for defense-related missions. Requests for information regarding the results of Part C should be directed to Lt. Lila Humphries, AFSD.

The study results from Parts A and B are reported in these volumes:

Volume I - Executive Summary

Volume II - Part A - SASP Special Emphasis Trade Studies

Volume II - Part B - Manned Space Platform Concepts*

Volume III - Programmatics for Manned Space Platform Concepts

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*Contains inputs from Hamilton Standard in select areas of ECLSS ($5000 subcontract).

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Section 1
INTRODUCTION

The recent launches of the Space Shuttle and the anticipated operation of the Spacelab in the near future are bringing new capabilities to the science and applications communities to accomplish missions in space. The new systems will facilitate the launch, retrieval, refurbishment and reflight of scientific payloads. While the Spacelab sortie mode of operation will continue to be an important tool for the science and applications users, efforts are also in progress to define an approach to provide a simple and cost-effective solution to the problem of long-duration space flight. This approach involves a Space Platform in low earth orbit, which can be tended by the Space Shuttle and which will provide, for extended periods of time, stability, utilities and access for a variety of replaceable payloads.

The program will also be evolutionary in nature. The addition of a pressurized module (which could be derived from Spacelab) to the Space Platform will provide a manned habitated orbital system. This manned space platform (space station) in low earth orbit is seen to be the next major capability needed for the areas of science, applications, technology and commerce. Such a capability offers the ultimate approach to capitalizing on the considerable synergism which is possible when man is used to complement equipment in orbit. The vast potential of this type of capability has been proven in Skylab and will be proven again in Spacelab. Because of the relative short duration of a Spacelab flight, there is also considerable interest among some investigators with manned payloads on Spacelab to reside for longer periods.

Moreover, the manned space platform concept must recognize the realities of budget constraints and payload availability, both of which combine to prescribe a vehicle of modest beginnings and yet flexible for growth into service for those major orbital operations that are emerging. It is apparent that the early manned space platform will support Spacelab-type and derivative payloads. Next, in preparation for later major operations, an interim step of advanced capability development must be accomplished. Finally, with such new capabilities, major operations will be implemented to support large structure assembly, orbital transfer vehicle basing

and spacecraft servicing. This latter activity is envisioned as feasible by the mid-1990s, if the enabling technology is developed in the early 1990s.

Basically, the technology to provide long-term residence for man in space is in hand and there are now payloads for science, applications and commerce in development which can utilize such a capability. The advanced capability to perform major complex operations must yet be developed and tested in orbit.

The study objective for the Manned Space Platform (Part B) was to define, evaluate and select concepts for establishing a permanently manned presence in space early, with a maximum of existing technology. The study included five tasks: Task B1 - Requirements Analysis for a Manned Space Platform, Task B2 - Concepts Identification, Task B3 - System Analysis and Definition, Task B4 - Comparison of Concepts and Task B5 - Programmatics.

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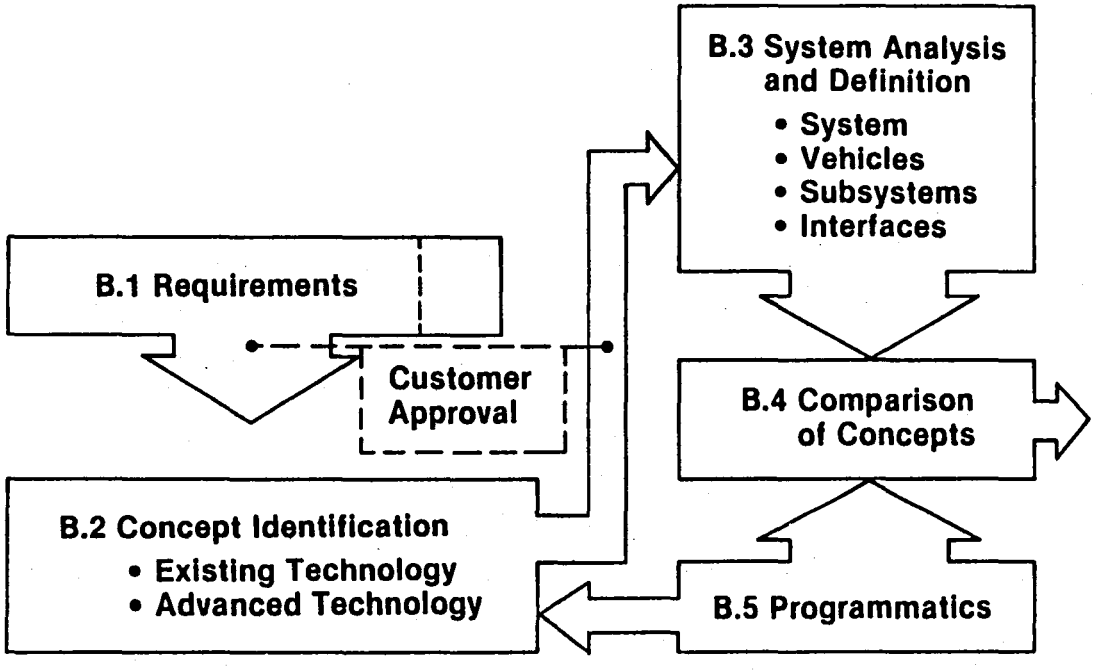
TASK B — MANNED PLATFORM CONCEPT



This volume presents the programmatic data for the reference concept of the Manned Space Platform (MSP). The following five sections provide details regarding our proposed work breakdown structure (WBS) and dictionary, the facilities and equipment required to produce the modules, the project schedule and logic diagram, a preliminary assessment of environmental impacts and details regarding the estimated costs for the reference concept.

Section 2 contains the proposed WBS which was developed to provide summary and system level segregation of the nonrecurring and recurring portions of the Manned Space Platform project. The accompanying dictionary outlines the function and activities contained within each WBS element.

Section 3 discusses the facility and equipment required to produce the various modules. Generally, required equipment is within the existing state of the art although the size of some of the items to be manufactured will be a consideration. A preliminary manufacturing flow has also been provided.

The project schedules are presented in Section 4, consisting of the Master Project Summary Schedule, the Master Project Phasing Chart and the Logic Network. Using the authority to proceed date provided by NASA, the schedule was developed based on an analysis of the requirements and considering similar requirements on like projects. The launch of the first modules is scheduled for 45 months following ATP.

A preliminary assessment of the environmental impacts of the Manned Space Platform is presented in Section 5. This discussion complies with the reporting requirements of NHB 8800.11 and in general concludes that no significant environmental impacts are foreseen.

Finally, Section 6 presents our cost estimates for the reference concept. This estimate has been structured consistent with the WBS and provides cost visibility among the DDT&E, manufacturing and operations phases. The estimates themselves were developed using parametric estimating techniques and appropriate cost estimating relationships. Both summary cost information and the supporting estimating details are provided in this section. A complete description of the reference concept is given in Volume II, Part B.

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KEY PROGRAM CONSIDERATIONS

- Foundation of Realistic Payloads
- Conservative Budget Assumptions
- Goals for Initial Capability
- Goals for Capability Growth Steps
- Capabilities of Power System
- Extent of Existing Equipment Use
- Revisit/Resupply Logistics Scope
- Safety and Contingency Management
- Involvement and Impacts of Participants Other Than NASA

SECTION 2

WORK BREAKDOWN STRUCTURE AND DICTIONARY

This document was prepared in response to Contract Data Requirements List item DR-5. It presents the proposed Work Breakdown Structure (WBS) chart (Figure 2-1) and the WBS dictionary. The dictonary describes the effort represented by each element of the WBS and is segregated into three categories: nonrecurring, recurring production; and, recurring operations. In making the determination as to the category of effort represented by a specific WBS element, it was assumed that only one set of ground support equipment and flight support equipment would be needed whereas more than one set of flight modules would be provided.

WBS 0.0 MANNED SPACE PLATFORM

This element represents the total labor and material required to design, develop, manufacture, assemble, test and launch the Manned Space Platform. Included are such activities as Project Management, System Engineering, Test and Evaluation, Launch and Mission Operations. Also included are all effort associated with providing the Ground Support Equipment (GSE) and Flight Support Equipment (FSE) needed by the platform's modules and Space Transportation System (STS) to launch, deploy and assemble, in orbit, the Manned Space Platform. The tasks have been separated in each WBS element to define the recurring and nonrecurring effort.

Work is not performed, nor are costs collected, in this WBS element. Rather, it summarizes the elements listed below:

WBS	TITLE
1.0	Project Management
2.0	System Engineering Integration
3.0	Manned Space Platform Modules
4.0	Test and Evaluation
5.0	Ground Support Equipment
6.0	Flight Support Equipment
7.0	Operations

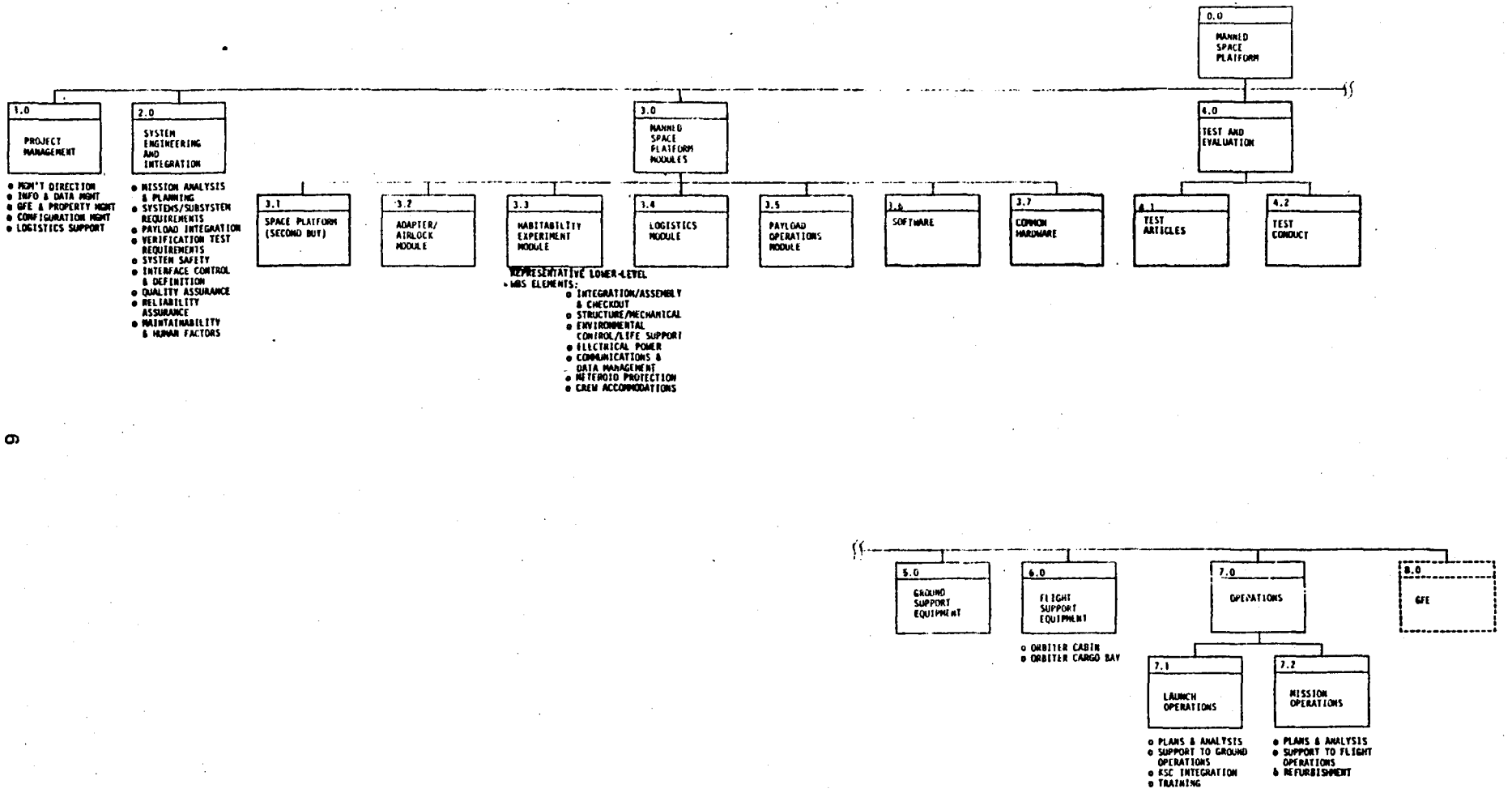


FIGURE 2-1

WBS CHART

WBS 1.0 PROJECT MANAGEMENT

This element contains the effort required to provide overall direction and control for the contracted effort, both the nonrecurring and recurring portions.

Included are such activities as: prepare implementation plans; prepare, release and maintain departmental budgets, schedules and work authorization documentation; conduct project status reviews; administer subcontracts; manage the acquisition and utilization of Government Furnished Property; implement procedures for configuration management, logistics support management, and data management.

WBS 2.0 SYSTEM ENGINEERING AND INTEGRATION

This element contains the effort required to provide an integrated technical approach to the design and development of the Manned Space Platform.

A. Nonrecurring

Representative tasks performed in this element are: establish system-level and module-level performance specifications, software requirements and interface drawings; perform reliability, maintainability, human factors, system safety, quality and logistics analyses and trade studies; prepare technical implementation plans; conduct the preliminary and critical design reviews; prepare the specification tree; identify long-lead items and GFE requirements.

B. Recurring-Production

Representative tasks performed in this element are: provide technical liaison with the customer; maintain system-level specifications and interface drawings.

WBS 3.0 MANNED SPACE PLATFORM (MSP)MODULES

This element represents the labor and material required to design, manufacture and deliver the various modules. Included is the modification of GFP for use on this project.

Work is not performed, nor are costs collected in this WBS element. Rather, it summarizes the elements listed below:

WBS	Title
3.1	Space Platform (2nd Buy)
3.2	Adapter/Airlock Module
3.3	Habitability Experiment Module
3.4	Logistics Module
3.5	Payload Operations Module
3.6	Software
3.7	Common Hardware

WBS 3.1 SPACE PLATFORM (Second Buy) (Recurring-Production))

This element contains the effort required to acquire a dedicated "standard" space platform. Tasks performed in this element include: issue procurement specifications; provide supplier liaison; perform receiving/acceptance inspection; pack and ship the modules.

WBS 3.2 ADAPTER/AIRLOCK MODULE

This element contains the labor and material required to modify the GFE Orbiter Airlock so that it can be used as the Adapter/Airlock Module.

Module subsystems include: structural/mechanical, environmental control/life support, electrical power, communications and data management, meteroid protection, crew accommodations.

WBS 3.2 (Continued)

A. Nonrecurring

Tasks performed in this element include: perform design analyses and trade studies; prepare preliminary and final design drawings; prepare procurement specifications; design and build manufacturing tools; prepare subsystem interface drawings.

B. Recurring-Production

Tasks performed in this element include: sustain engineering design drawings; maintain tooling; procure raw material and purchased parts; fabricate deliverable hardware; perform receiving, source and in-line inspections; maintain subsystem interface drawings; perform acceptance tests on the completed units; pack and ship the modules.

WBS 3.3 HABITABILITY/EXPERIMENT MODULE

This element contains the labor and material required to design, manufacture and deliver the Habitability/Experiment module. This module is an adaptation of the two-segment Spacelab module.

Module subsystems include: structural/mechanical, environmental control/life support, electrical power, communications and data management, meteroid protection, crew accommodations.

A. Nonrecurring

Tasks performed in this element include: perform design analyses and trade studies; prepare preliminary and final design drawings; prepare procurement specifications; design and build manufacturing tools; prepare subsystem interface drawings.

B. Recurring-Production

Tasks performed in this element include: sustain engineering design drawings; maintain tooling; procure raw material and purchased parts; fabricate deliverable hardware; perform receiving, source and in-line inspections; maintain subsystem interface drawings; perform acceptance tests on the completed units; pack and ship the modules.

WBS 3.4 LOGISTICS MODULE

This element contains the labor and material required to design, manufacture and deliver the Logistics Module. This module is an adaptation of the single-segment Spacelab module.

Module subsystems include: structural/mechanical, environmental control/life support, electrical power, communications and data management, meteroid protection, crew accommodations.

A. Nonrecurring

Tasks performed in this element include: perform design analyses and trade studies; prepare preliminary and final design drawings; prepare procurement specifications; design and build manufacturing tools; prepare subsystem interface drawings.

B. Recurring-Production

Tasks performed in this element include: sustain engineering design drawings; maintain tooling; procure raw material and purchased parts; fabricate deliverable hardware; perform receiving, source and in-line inspections; maintain subsystem interface drawings; perform acceptance tests on the completed units; pack and ship the modules.

WBS 3.5 PAYLOAD OPERATIONS MODULE

This element contains the labor and material required to design, manufacture and deliver the Payload Operations Module. This module is an adaptation of the single-segment Spacelab module. (Costs for this module are not contained herein.)

Module subsystems include: structural/mechanical, environmental control/life support, electrical power, communications and data management, meteroid protection, crew accommodations.

A. Nonrecurring

Tasks performed in this element include: perform design analyses and trade studies; prepare preliminary and final design drawings; prepare procurement specifications; design and build manufacturing tools; prepare subsystem interface drawings.

WBS 3.5 PAYLOAD OPERATIONS MODULE (Continued)

A. Recurring-Production

Tasks performed in this element include: sustain engineering design drawings; maintain tooling; procure raw material and purchased parts; fabricate deliverable hardware; perform receiving, source and in-line inspections; maintain subsystem interface drawings; perform acceptance tests on the completed units; pack and ship the modules.

WBS 3.6 SOFTWARE

This element contains the effort required to design and develop, validate, and maintain subsystem and system software.

A. Nonrecurring

Tasks performed in this element include: review requirements for baseline mission software; design and develop subsystem and system software; test and validate the software; document the finalized software.

B. Recurring Operations

Tasks performed in this element include: design, develop, validate and document changes to the baseline software to accommodate mission/launch variations.

WBS 3.7 COMMON HARDWARE (Nonrecurring)

This element contains the labor and material required to design that hardware that is common to two or more of the MSP Modules. Common equipment includes: environmental control/life support, communications and data management, berthing ports.

Tasks performed in this element include: perform design analyses and trade studies, prepare preliminary and final design drawings; prepare procurement specifications; prepare appropriate interface drawings.

Note: Each using module purchases/manufactures its own hardware.

WBS 4.0 TEST AND EVALUATION

This element represents the labor and material needed to plan, conduct and evaluate module and system-level (i.e., those involving elements of two or more modules and/or portions of the Space Transportation system (STS) development and qualification tests. Also provided herein are deliverable mockups.

Work is not performed, nor are costs collected in this WBS element. Rather, it sumarizes the elements listed below:

WBS	Title
4.1	Test Articles
4.2	System Tests

WBS 4.1 TEST ARTICLES (Nonrecurring)

This element contains the labor and material required to design and build that unique hardware which is assigned to the development and qualification test program. Also included are test instrumentation, special test fixtures/test equipment, and deliverable mockups.

Representative tasks performed in this element include: prepare design drawings/procurement specifications; procure raw material and purchased parts; build and assemble the test hardware; package and ship the hardware to the using location.

WBS 4.2 TEST CONDUCT (Nonrecurring)

This element contains the labor and material required to plan, conduct and evaluate module and system-level development and qualification tests.

Representative tasks performed in this element include: prepare test plans and procedures; coordinate test activities; set up test configuration; conduct tests; evaluate test data and prepare test reports; disassemble test configuration and dispose of test material. Also included is the cost of test consumables.

WBS 5.0 GROUND SUPPORT EQUIPMENT (Nonrecurring)

This element contains the labor and material required to design, manufacture, assemble, test and deliver the MSP ground support equipment. This equipment is used to service, transport, hoist, repair, overhaul, assemble, disassemble, test, inspect or otherwise prepare/maintain the MSP modules prior to the modules being launched.

Representative tasks performed in this element include: perform design analyses and trade studies; prepare preliminary and final design drawings; prepare procurement specifications; design and build manufacturing tools; procure raw material and purchased parts; build development test specimens; conduct development and qualification tests; build deliverable hardware; perform receiving, source and in-line inspections. Also included are: prepare and maintain interface drawings; perform acceptance tests on the completed units, pack and ship the units to their using location.

WBS 6.0 FLIGHT SUPPORT EQUIPMENT (Nonrecurring)

This element contains the labor and material required to design, manufacture, assemble, test and deliver the MSP flight support equipment. This equipment, which may be located in either the Orbiter's cabin or cargo bay, supports and maintains the MSP modules during the time the modules are in the cargo bay.

Representative tasks performed in this element include: perform design analyses and trade studies; prepare preliminary and final design drawings; prepare procurement specifications; design and build manufacturing tools; procure raw material and purchased parts; build development test specimens; conduct development and qualification tests; build deliverable hardware; perform receiving, source and in-line inspections. Also included are: prepare and maintain interface drawings; perform acceptance tests on the completed unit, pack and ship the units to their using location.

WBS 7.0 OPERATIONS

This element represents the contractor effort required to plan, coordinate and support the pre-launch, launch, deployment and recovery/refurbishment operations pertaining to the Manned Space Platform's modules.

Work is not performed, nor are costs collected, in this WBS element. Rather, it summarizes the elements listed below:

WBS	Title
7.1	Launch Operations
7.2	Mission Operations

WBS 7.1 LAUNCH OPERATIONS (Recurring Operations)

This element contains the effort required to plan, coordinate and support the launch activities.

Representative contractor tasks performed in this element include: provide inputs to launch plans and procedures; participate in the launch site receiving inspection of each module; assist in the installation/integration of module equipment and subsequent checkout; participate in the joining of Oriter and modules; conduct pre-launch checkout; participate in the conduct of the launch servicing and countdown operations; participate in operations reviews and readiness meetings; monitor module instrumentation during powered flight and pre-deployment operations. These activities will be repeated for each launch. Also included are activities associated with training personnel in the assembly, checkout and maintenance of the platform's hardware.

WBS 7.2 MISSION OPERATIONS (Recurring Operations)

This element contains the contractor effort required to plan, coordinate and support the platform's post-launch operations. During these operations the various modules will be removed from the Orbiter (deployed) and joined together to form an operational MSP.

WBS 7.2 MISSION OPERATIONS (Recurring-Operations) (Continued)

Representative tasks performed in this element include: provide inputs to orbital deployment/assembly/recovery/refurbishment plans and procedures; provide technical liaison during these activities; monitor module instrumentation; particpate in operations reviews and readiness meetings.

Section 3
FACILITY REQUIREMENTS

3.1 INTRODUCTION

This section describes the facility requirements for effectively accomplishing the fabrication, assembly, subsystem testing and integration of the manned space platform. While this assessment is made at a time that the definition of engineering design and requirements is limited, our experience in design and manufacture of man-rated space systems supports a very high level of confidence in the findings provided herein.

The complexity of this program dictates that the latest technologies in computer-aided design/computer-aided manufacture be utilized. This should include the capability for three-dimensional geometric modeling to permit the design engineer to create a part or assemble a number of parts into one drawing. This system can then produce fully dimensioned drawings and the computer files can be accessed by other computers for planning, procurement, tooling and NC machining.

3.2 FACILITIES

The facilities required to manufacture the manned space platform are all within the existing "state of the art" technologies; however, the size of the equipment exceeds that usually associated with conventional manufacturing capabilities. Some of the mills must accommodate skins up to 10 feet x 24 feet. Turning equipment must turn 10-foot diameter rings. Welding equipment must weld up to 24 feet long beads and process tanks and accommodations must be sized accordingly. In addition, the buildings for assembly and test must be laid out with aisles, hook clearances and move space that will accommodate these large structures.

The generic names of the types of equipment are summarized below. As the definition of the Manned Space Platform progresses, more detailed information regarding this equipment will be developed.

3.2.1 Fabrication and Assembly Equipment

Machine Shop Equipment

- Skin mills
- Mills, horizontal
- Mills, vertical
- Drills, vertical
- Lathes
- Profilers
- Jig borers
- Laps
- Hones
- Grinders
- Saws
- Deburr

Sheet Metal Equipment

- Shears
- Rolls
- Breaks
- Forming presses
- Stretchers
- Shrinkers
- Spin form lathes
- Tube fabricators
- Nibblers
- Riveters
- Routers
- Saws
- Shapers
- Swagers

Processing Equipment

- Sandblast
- Anodize
- Alodine
- Plating
- Heat treat
- Passivate
- Degrease
- Strip
- Dry lube
- Paint
- Stress relieve
- Embrittle relief
- Aging

Assembly Equipment

- Riveting
- Bonding
- Sealing
- Soldering
- Fasteners (special)
- Brazing
- Tube welding
- Sewing
- Welding

Inspection Equipment

Dimensional check	Dye penetrant inspection
Magnetic particle inspection	Hardness inspection
Fluorescent penetrant inspection	Electrical test
Ultrasonic inspection	Hydraulic test
Radiographic inspection	

3.2.2 Electronics Manufacturing Equipment

Printed circuit board fabrication	Thick film fabrication, assembly and test
Manufacturing graphics	Wire preparation
Component preparation and kitting	Harness and cable assembly
Printed circuit board assembly	Console assembly
Black box assembly	Encapsulation
Assembly test	

3.2.3 Buildings

110,000 square feet of fabrication area

80,000 square feet of assembly area (factory clean)

90,000 square feet of environmentally controlled area

90,000 square feet for laboratory and tests

3.2.4 Laboratories and Systems Test Structures

Structures laboratory	Adhesives laboratory
Strain-gage laboratory	Finishes and environmental exposure
Experimental stress laboratory	Metallurgical laboratory
Vibration test facility	Welding laboratory
Shock simulation facility	Scanning electron microscope
High-temperature composites laboratory	Thermophysical properties
Elastomer and fabrics laboratory	Electrical materials and sealants
Instrumental analysis laboratory	Chemistry laboratory
Space environments laboratory	Nondestructive testing
Mechanical properties test laboratory	

Electronics

Sensor evaluation
Microwave
Electronic systems
Inertial systems
Target signature
Pattern recognition
Process laboratories
Component evaluation
Semiconductor devices
Circuit study laboratory

3.2.5 Computers

Data reduction
Hybrid computing
CAD/CAM
Engineering work station

3.3 MANUFACTURING PLAN

To further illustrate the facilities and equipment envisioned for use in the manufacture of the Manned Space Platform, the conceptualized manufacturing flow is displayed in Figure 3-1.

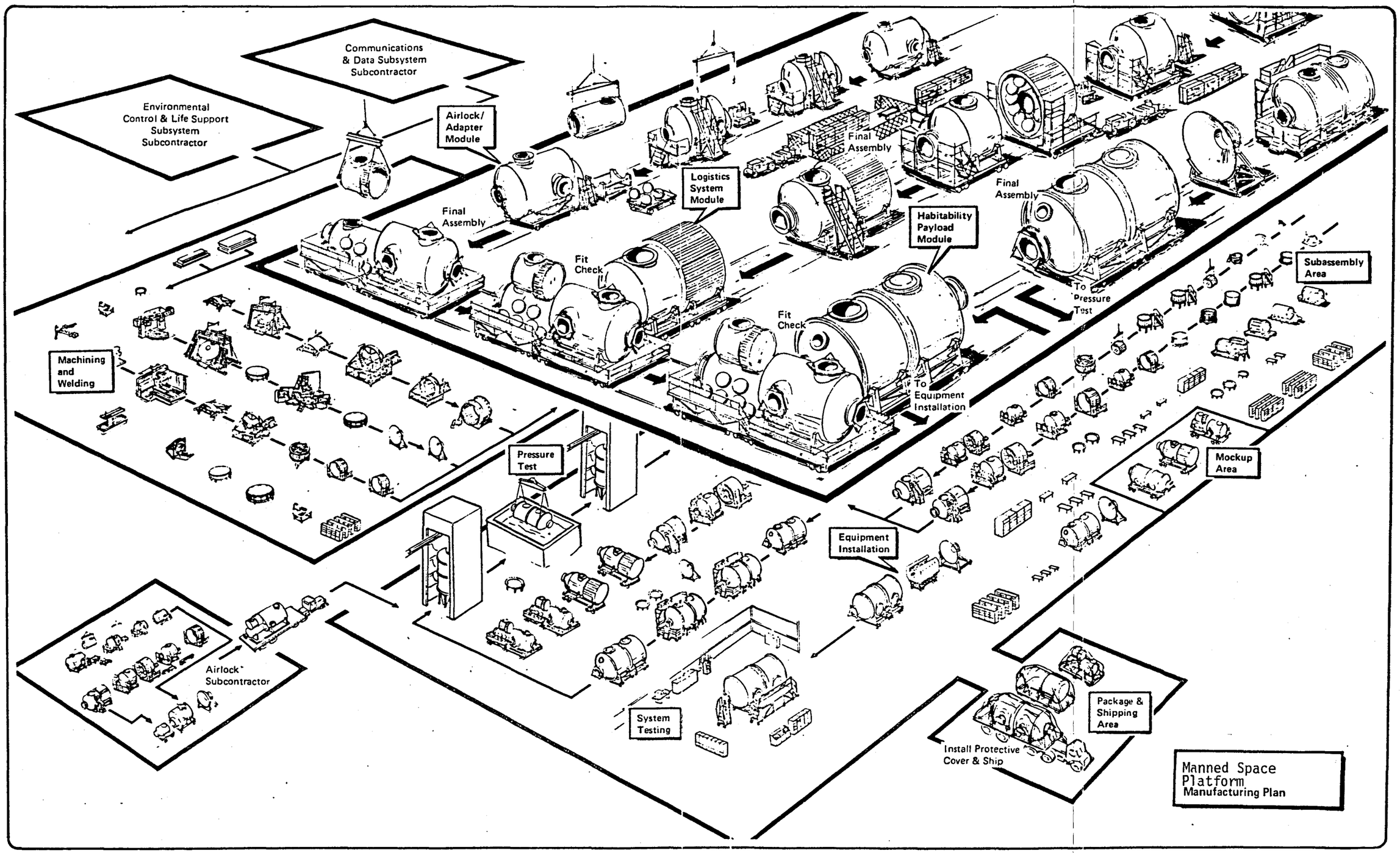

Communications & Data Subsystem Subcontractor
Environmental Control & Life Support Subsystem Subcontractor
Airlock/ Adapter Module
Logistics System Module
Habitability Payload Module
Final Assembly
Final Assembly
Final Assembly
Fit Check
Fit Check
To Pressure Test
To Equipment Installation
Machining and Welding
Pressure Test
Subassembly Area
Mockup Area
Equipment Installation
Airlock Subcontractor
System Testing
Package & Shipping Area
Install Protective Cover & Ship
Manned Space Platform
Manufacturing Plan

Figure 3-1

Section 4
PROJECT SCHEDULES

This section presents the project schedule, phasing plan and summary logic network for the Manned Space Platform. These submittals are designed to provide an overall understanding of the schedule logic, identify the critical path and display the relative flows of the major tasks.

The Master Summary Schedule, Figure 4-1, shows the major milestones from Authority to Proceed (ATP) through the launch of the second Logistics Module. Complementing this data are summary schedules for each WBS element to the second level for functional areas and to the third level for the hardware elements.

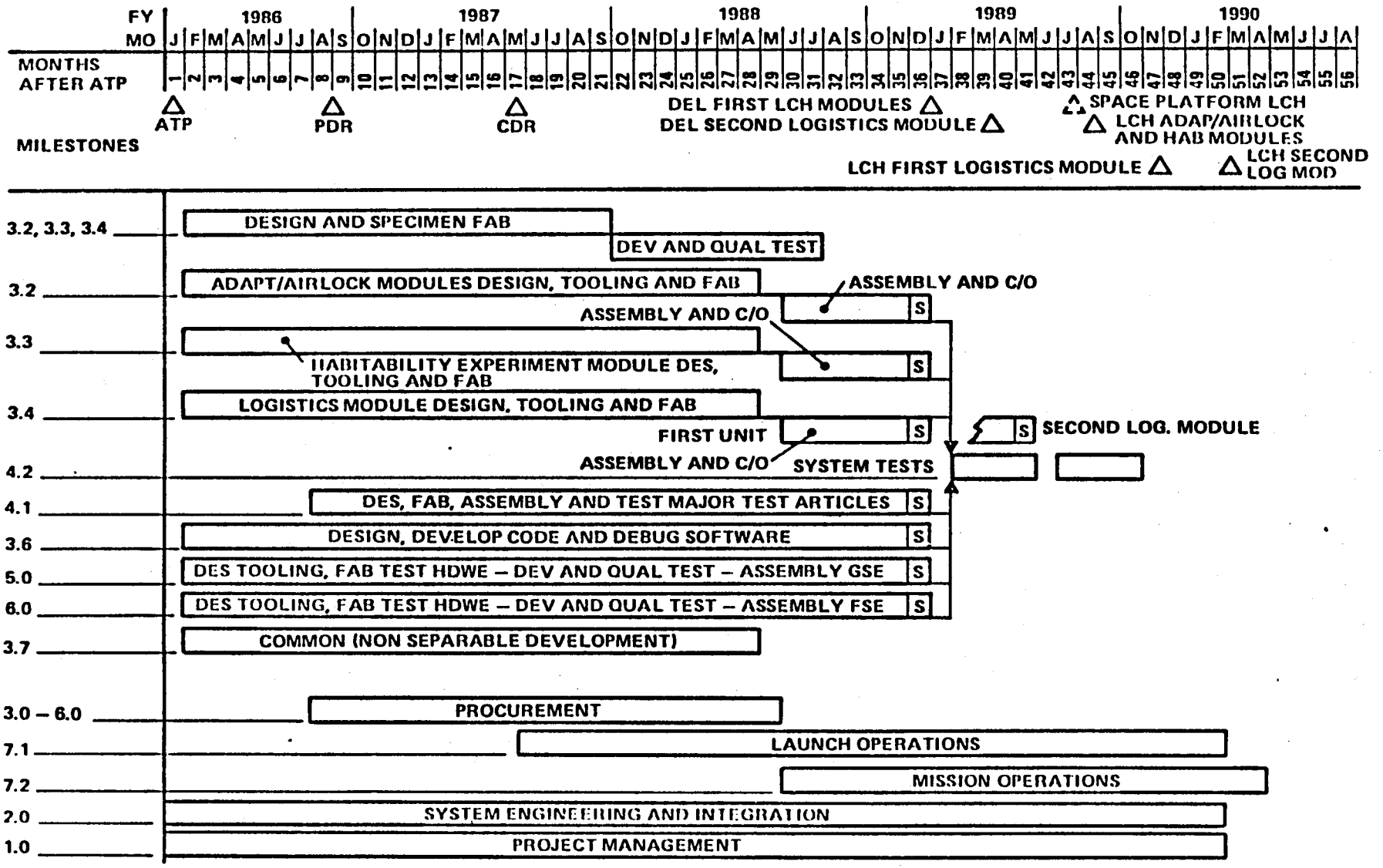
As shown on this Master Summary Schedule, there is a 44-month span between ATP and launch of the initial module segments. This launch date provides reasonably sufficient time from completion of the review milestones (PDR and CDR) to complete fabrication and assembly operations prior to the conduct of systems test and evaluation in fiscal 1989. The timing for the major reviews (PDR and CDR) of nine months and 17 months after ATP, respectively, was based on an analysis of related requirements on similar programs, specifically Space Platform.

The Master Project Phasing Schedule (Figure 4-2) provides additional visibility to lower WBS element levels while also displaying in summary format the interaction among the related elements.

The Logic Network (Figure 4-3) illustrates the interdependency of project tasks beginning with initial system and subsystem design analyses and requirements and continuing through launch. The structural/mechanical subsystem has been identified as the critical path of this network. The context in which this term is used, however, is not intended to imply a day for day slip if any milestone along the path is delayed. Rather it recognizes that the structural/mechanical path is the longest in duration and its importance thus needs to be underscored as a key to achieving project objectives.

Figure

MANNED SPACE PLATFORM MASTER SUMMARY SCHEDULE



MANNED SPACE PLATFORM
MASTER PROJECT PHASING SCHEDULE

CY: 1986 | 1987 | 1988 | 1989 | 1990 | 91

MONTHS FROM ATP: J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F

PROGRAM MILESTONES:
- ATP
- PDR
- CDR
- DEL 1ST LCH MODULES
- SPACE PLATFORM LAUNCH
- DEL 2ND LOGISTICS MODULE
- LCH ADAPT/AIRLOCK & HAB MODULES
- LAUNCH 1ST LOGISTICS MODULE
- LCH 2ND LOG MODULE

WBS	TASK DESCRIPTION	
1.0	PROJECT MANAGEMENT	
2.0	SYSTEM ENGINEERING & INTEGRATION	
3.0	MANNED SPACE PLATFORM MODULES	
3.1	SPACE PLATFORM LAUNCH	△
3.2	ADAPTER/AIRLOCK MODULES	
	STRUCTURAL/MECHANICAL	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	ENVIRONMENTAL CONTROL/LIFE SUPPT	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	ELECTRICAL POWER	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	COMMUNICATIONS & DATA MANAGEMENT	ANALYSES | PROCUREMENT/CODE | INTEGRATE
	METEROID PROTECTION	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	CREW ACCOMMODATIONS	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	FINAL ASSEMBLY & CHECKOUT	S
3.3	HABITABILITY EXPERIMENT MODULE	
	STRUCTURAL/MECHANICAL	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	ENVIRONMENTAL CONTROL/LIFE SUPPT	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	ELECTRICAL POWER	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	COMMUNICATIONS & DATA MGMT	ANALYSES | PROCUREMENT/CODE | INTEGRATE
	METEROID PROTECTION	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	CREW ACCOMMODATIONS	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	FINAL ASSEMBLY & CHECKOUT	S
3.4	LOGISTICS MODULE	
	STRUCTURAL/MECHANICAL	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	ENVIRONMENTAL CONTROL/LIFE SUPPT	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	ELECTRICAL POWER	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	COMMUNICATIONS & DATA MANAGEMENT	ANALYSES | PROCUREMENT/CODE | INTEGRATE
	METEROID PROTECTION	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	CREW ACCOMODATIONS	ANALYSES | DESIGN/PROCUREMENT/TOOLING | FAB, S/ASSY & TEST
	FINAL ASSEMBLY & CHECKOUT	1ST UNIT S; 2ND S
3.6	SOFTWARE	ANALYSES | PROGRAM DEVELOPMENT & CODING | DEBUGGING S
3.7	COMMON (NON SEPARABLE DEV)	
3.0	DEVELOPMENT & QUALIFICATION TESTS	ANALYSES | DESIGN/PROCURE/FAB SPEC'S | DEV TESTS | QUAL TESTS
4.0	SYSTEM TEST AND EVALUATION	
4.1	MAJOR TEST ARTICLES	DESIGN & PROCUREMENT | FAB ASSY & TEST S
4.2	SYSTEM TESTS	
5.0	GROUND SUPPORT EQUIPMENT	ANALYSES | DES/PROCURE/TOOLING/TEST NONE FAB & DEV & QUAL TESTS | FAB, ASSY & TEST S
6.0	FLIGHT SUPPORT EQUIPMENT	ANALYSES | DES/PROCURE/TOOLING/TEST NONE FAB & DEV & QUAL TESTS | FAB, ASSY & TEST S
7.0	OPERATIONS	
7.1	LAUNCH OPERATIONS	
7.2	MISSION OPERATIONS	

CY: 1986 | 1987 | 1988 | 1989 | 1990 | 91

MONTHS FROM ATP: J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F M A M J J A S O N D | J F

APPROVED BY:
PROGRAM MANAGER:

PREPARED BY: E. P. MONIE
A3-149
SCHEDULES, PLANNING & CONTROL

SCHEDULE NO.
NMSP-0.2-1.0

REVISED: 24 FEB 1982
SUPERSEDES: 13 JAN 1982

PAGE 1 OF 1

Figure 4-2
Master Project Phasing Schedule

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Section 5
ENVIRONMENTAL ANALYSIS

5.1 SUMMARY AND CONCLUSIONS

The proposed action is to provide a manned space platform.

The basic program concept of utilizing existing technology and equipment will minimize the environmental impact associated with the commitment of resources during the design and manufacturing phase. Existing manufacturing facilities presently comply with environmental regulations such as the Clean Air Act and the Federal Water Pollution Control Act.

The manned space platform utilizes the Space Shuttle as the launch vehicle and the Space Platform as the basic subsystems module.

The majority of environmental impacts associated with the launch and orbit phase of this action have been previously addressed in the environmental impact statement of the Space Shuttle program and the environmental assessment of the Space Platform.

No significant environmental impact has been identified by this environmental analysis.

5.2 PURPOSE AND NEED

The purpose of the manned space platform is to provide a manned facility in low earth orbit which uses the Space Platform. To adequately exploit the investment in the Space Shuttle and Spacelab, and to more completely satisfy the needs of the scientific and space applications disciplines, an advancement in our capability to support increasingly more demanding space operations is required.

5.3 DESCRIPTION OF PROPOSED ACTIONS AND ALTERNATIVES

The manned space platform studies define the requirements for an early manned platform and the evolving requirements which could necessitate larger and longer duration, permanent-manned facilities in space.

A viable approach for evolving manned platforms by either of two alternatives was investigated: (1) an initial early Shuttle-tended (manned only when docked to Orbiter) and then to permanent-manned (permanent facility, continuously manned) facilities or (2) directly to the latter in response to evolving mission requirements.

These studies define an early manned platform and the additional modules/ elements needed for an evolutionary growth to establishing a permanent-manned presence in space.

5.4 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

5.4.1 Manned Platform Concept

Manufacturing Phase

The concept of existing technology and equipment from Skylab, Orbiter and Spacelab will minimize the need for new manufacturing facilities. The manned space platform concept should not have any additional manufacturing phase environmental impacts as compared to the basic Space Platform.

Prelaunch and Launch

The manned platform concept should reduce the number of Shuttle launches to accomplish the same scientific application missions. Man as an interactive component should reduce the complexity of the science application subsystems. The evolutionary concept leading to larger crews and extended resupply cycles should reduce the number of Shuttle launches and the impacts associated with those launches.

Orbiting Phase

The orbiting phase concerns that are in addition to the impacts noted in the unmanned section are the discharges of the environmental control and life support systems. These discharges are composed of oxygen, nitrogen, water vapor and carbon dioxide from spacecraft leakage and overboard dumps. All of these gases naturally occur in the earth's atmosphere and are not considered air pollutants.

5.4.2 No Action

The result of no action would be to severely curtail, or in some cases cancel, many science and application missions now envisioned for the late 80s and early 90s.

SECTION 6
COSTING APPROACH, METHODOLOGY AND RATIONALE

This section presents the cost estimate for the Manned Space Platform based on the selected concept described in Volume II, Part B.

6.1 GROUNDRULES AND ASSUMPTIONS

The following groundrules and assumptions were used to construct the cost estimate:

1. All costs are in constant mid-fiscal 1981 dollars.
2. Costs exclude prime contractor fee.
3. ATP is January 1986. Delivery of the Adapter/Airlock, Habitability and first Logistics Module is January 1989. Delivery of second Logistics Module is April 1989. Launch of the Adapter/Airlock and Habitability Modules is September 1989. Launch of first Logistics Module is December 1989 and the second is March 1990.
4. Costs were derived anticipating utilization of Spacelab equipment wherever possible.
5. Spacelab costs were furnished by NASA.
6. Spacelab subsystem hardware costs are included with the following conditions:
   a. The existing Spacelab vendors are available when the hardware is needed.
   b. There is an interruption in the production lines, but the lines have not been dismantled.
   c. The hardware does not need requalification.
   d. The costs furnished by NASA are assumed to be for a follow-on replication unit. They have been converted to first unit costs to cover restart costs.
   e. Where subsystem costs are used, a 43% factor was applied to cover vendor programmatic costs. This factor was based on the ratio of costs for like services provided in the cost data from NASA.
7. The orbiter Airlock Module costs were furnished by NASA.

6.1 GROUNDRULES AND ASSUMPTIONS (Cont'd)

8. Design of the MSP is a functional concept rather than a point-design. Equipment specified will not necessarily be used item by item; rather equipment that will perform the same or is functionally similar will be used.
9. The costs include the design, test, fabrication, assembly, checkout and delivery of one Airlock/Adapter, one Habitability and two Logistics Modules.
10. Initial spares costs (through the second Logistics Module launch) are included.
11. One equivalent unit of all flight hardware except the Space Platform is fabricated for test and evaluation.
12. GSE costs of 12% of all flight hardware included.
13. The cost for the Space Platform was furnished by NASA. This cost was based on the 12kW configuration which would to be adequate for the minimum (low cost start up) program.
14. The Space Platform configuration assumed for growth configurations beyond the "minimum basic" would provide 25kW of electrical power, have full (25kW) thermal capacity, KU band (hi rate) data handling, attitude and orbit reboost capability, three fully rotating payload ports mounted on extension structure (similar to first order platform defined in previous SASP study), and a rotating orbiter interface adapter.
15. Final System functional tests and checkout are performed as the separate hardware modules are joined at KSC.
16. The accuracy of the costs are commensurate with the depth of the design detail and reflect the status of a functional, conceptual design configuration.
17. The operations cost include the prime contractor costs to support the operations at KSC through mating of all modules and insertion into orbit from the STS.
18. NASA costs, or any other government institutional costs, are excluded.
19. Costs for personal equipment, food, gases, fluids, consumable payload and payload equipment, payload instrumentation and monitoring are excluded, except to the extent that they are included in the Space Platform . The Life Sciences Payload Installation Rack and Solar Functional Rack normally in the Spacelab are also excluded.

6.1 GROUNDRULES AND ASSUMPTIONS (Cont'd)

20. Shuttle related launch, orbiting and refurbishing costs are not included.
21. No orbiter crew or on-orbit operations costs are included. (Costs of ground support effort is included to the extent defined in Item 17).

6.2 COST METHODOLOGY

The costs for the MSP were estimated using parametric procedures, available vendor data, NASA data, direct estimates and appropriate factors. Estimate based on vendor, parametric and factor information used historical data from MDAC Data Bank, Procurement Files and pricing information. They reflect MDAC experience in the SIVB, Solid Rocket Booster, Titan Shroud, Delta, Workshop, Spacelab Tunnel, and PAM Programs. When CER's were used, the dollar values were escalated using tables reflecting the current aerospace manufacturing index. Where manpower estimates were used, the cost were based on the approved forward pricing rates. Where vendor estimates and other historical data were used as throughputs, costs were escalated by the appropriate factors from the same table used for escalating CER's.

As an example, a typical CER is the one used for calculating the cost of the active docking ports. This port has the mechanical latching mechanism and the active port of the umbilical carrying the thermal, data and electrical lines. The nonrecurring CER is:

$$\text{Cost 1980 \$} = 260500\ (\text{Weight})^{.516}\ [1 + (\text{Integration})\ (\text{Number of difference installations})^{.5}]$$

The integration factor covers the cost of mounting the port on the module. Its magnitude recognizes the ports include fluid and electrical interfaces as well as structure. The number of different installations recognizes the port is installed in several different locations and the interfaces in these locations are not identical. The .5 power factor recognizes that installing the port in two locations requires more effort than installing in one location; but two locations do not require twice the effort of one because there are similarities in the interfaces.

The exponent, 0.5, provides for a 60% decrease in integration effort for the second installation, 72% decrease for the third. The latter factor was used in this case since the ports were judged to be installed in the equivalent of three dissimilar locations, one on a large end cone, one on the end of the tunnel, and one on the side of a cylinder.

6.2 COST METHODOLOGY (Cont'd)

The nonrecurring hardware cost derived from the above equation includes the cost of the engineering design including drawings, layouts, and analyses. It includes a small amount for test labor, test specimens and test setup and tooling such as required for development tests. It does not include costs for qualification test hardware or system test. These are calculated separately and added to obtain the total nonrecurring engineering and testing cost of the hardware assembly. The basic nonrecurring costs for each item was adjusted to reflect whether the item was a new development, off-the-shelf item, or an existing item that required modification to meet the requirements of this program. If an item was considered off-the-shelf/qualified design, a minimum of 10% of the cost of the new item was added to cover such effort as locating the item, verifying it met the requirements and including the item on appropriate drawings, specifications and parts lists. If an item required modification, a larger factor was used. In addition, if an item was similar to another item, even though both were new items, the development cost of the least complex of the items was decreased to recognize the cost reducing carry-over between the items.

The CER for the recurring cost associated with the active docking ports is:

$$T_1 \text{ 1981 \$} = 7320 \text{ (Weight)}^{.757} \text{ (Integration)}$$

The integration factor used for recurring costs has no power on it since each unit is integrated. The total recurring cost is computed by multiplying the first unit cost by the number of items required. Vendor estimates were used when such costs were available and the type of items required could be associated with specifc off-the-shelf configurations. Vendor costs were used extensively in estimating the Environmental Control and Life Support subsystems. The costs were derived from Orbiter type equipment.

6.3 TEST PHILOSOPHY

The test philosophy assumed maximum reuse of all test specimens. Qualification and systems test articles were assumed to be refurbished and reused. Component testing was emphasized and testing of assemblies avoided where possible. One equivalent unit of hardware was assumed to be required as test specimens and an additional 20% added for refurbishment costs. As the design becomes more mature an indepth analysis of the testing requirements for each article would refine this cost and permit differentiating between items not requiring test because they are already qualified and items requiring extensive testing.

6.4 HARDWARE DEFINITION AND USAGE LIST

This cost estimate includes the following four modules: Space Platform, Adapter/Airlock, Habitability and Logistics Modules.

The Space Platform is a full capability, 25kW thermal and electrical power system. It has three rotating payload ports mounted on extension arms. Each port has thermal, electrical, and data umbilical interface as well as providing mechanical latching mechanisms. The module has attitude control and orbit reboost capability including thrusters, CMG's and electromagnetic torquers and the appropriate sensors and controls. It has KU band communications and high data rate recorders.

The Adapter/Airlock Module is a dual module composed of the Orbiter Airlock assembled on the side of a cylindrical tunnel which extends from a Spacelab type cylindrical shell. Both the external and internal structure of the adapter section is new design but similar to the Spacelab. The Adapter has six ports: two active side ports, one active top port, one active end port, one passive port on the tunnel and one passive port on the bottom. The eight hatches in the Adapter/Airlock are existing orbiter type. Each of the four active ports have hatches. A fifth hatch is in the lower passive port and a sixth between the tunnel and cylinder segment. The two remaining hatches are part of the airlock.

The Habitability Module is a two segment Spacelab. All the internal structure and equipment in the Spacelab core segment is utilized. The internal floor structure of the Experiment Segment of the Spacelab is modified slightly but the racks and equipment are not required. One active and one passive port and orbiter hatches are added to the ends of the module. New keel and trunnion fitting supports are required.

The Logistics Module uses the shell structure of the Experiment Segment of the Spacelab. It has a cylindrical tunnel extending from one dome and a cylindrical skirt covering the fluid storage bottles mounted around the tunnel.

6.4 HARDWARE DEFINITION AND USAGE LIST (Cont'd)

The internal structure is all new design. One active and one passive port is on the end of the module. Each port has a hatch and an additional hatch between the tunnel and the cabin. The cabin is pressurized and the tunnel, although pressurizable, is normally not pressurized.

The exterior surface of each module is covered by a multilayer insulation. The outer layer is a fiberglass sheet. The insulation also doubles as a meteoroid shield.

A complete listing of the hardware comprising the various modules is set forth in Table 6-1. The configuration of the MSP is shown below in Figure 6-1.

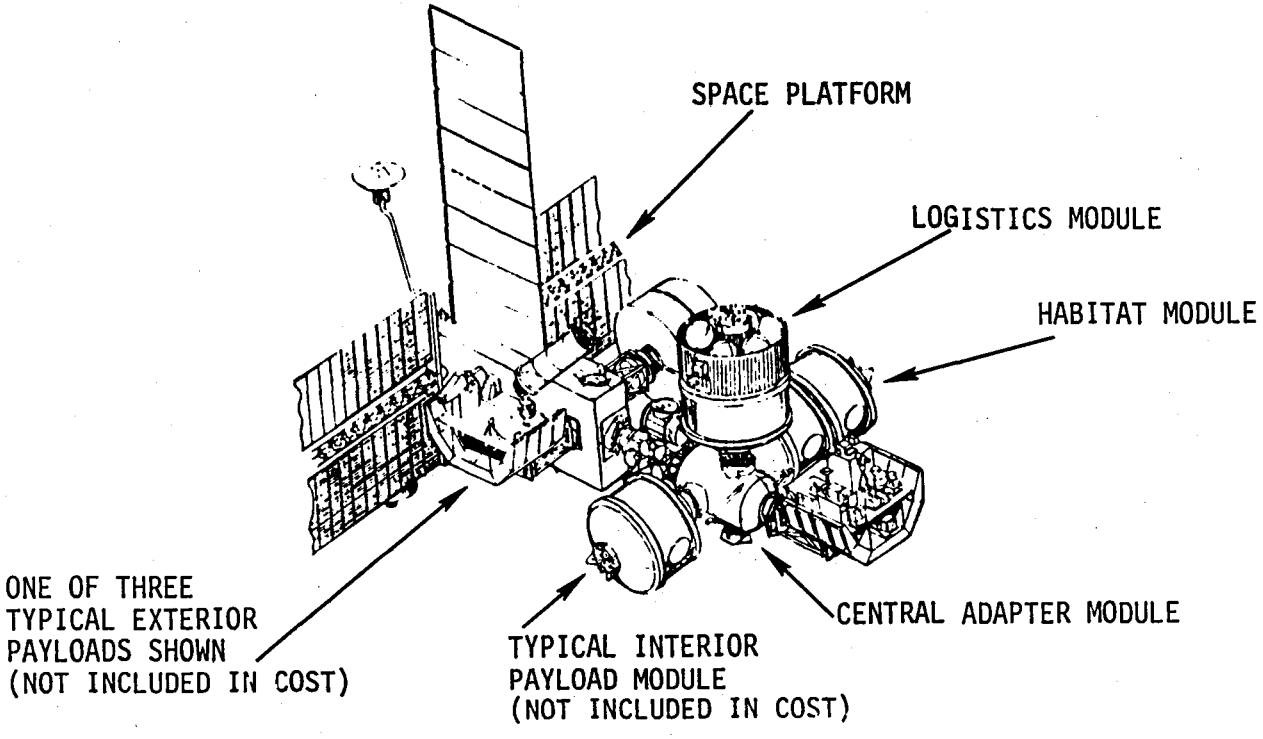

FIGURE 6-1
MANNED SPACE PLATFORM

MSP
FLIGHT HARDWARE DESCRIPTION

STRUCTURE	ADAPTER/AIRLOCK QTY	ADAPTER/AIRLOCK UNIT WT(LB)	HABITABILITY QTY	HABITABILITY UNIT WT(LB)	LOGISTICS QTY	LOGISTICS UNIT WT(LB)
Ports - Active	4	259.0	1	259.0	2	259.0
Ports - Passive	2	119.0	1	119 0	2	119.0
Hatches	6	101.0	2	101.0	6	101.0
Keel Support	1	70.0	1	101.0	2	101.0
Trunion Support	4	57.5	4	46.8	8	46.8
Ext Insulation	1	1040.0 ft^2	1	1096.0 ft^2	2	710.0 ft^2
Floor	1	233.0	1	693.0	2	390.0
Racks	1 Set	345.0	1 Set	892.0	2 Sets	892.0
Miscellaneous	1	270.0	1	323.0	2	508.0
Cylinder	1	584.0	0	-	2	1492.0
Dome - Welded	1	151.0	0	-	2	159.0
Dome - Machined	2	131.5	0	-	-	-
Tunnel	1	507.0	0	-	4	623.0
Tunnel Str. Assy.	1	115.0	0	-	-	-
Orb. Airlock	1	900.0	0	-	0	-
Spacelab	0	-	1	(2 segment)	2	(single segment)

TABLE 6-1 EQUIPMENT LIST (Page 1 of 6)

MSP
FLIGHT HARDWARE DESCRIPTION

ECLS	ADAPTER/AIRLOCK QTY	ADAPTER/AIRLOCK UNIT WT(LB)	HABITABILITY QTY	HABITABILITY UNIT WT(LB)	LOGISTICS QTY	LOGISTICS UNIT WT(LB)
Water Tanks	16	40.0	0	-	36.0	40.0
Water Separator	1	22.0	*	-	0	-
Water Processor	1	165.0	*	-	0	-
Water Pump Pack	1	28.0	*	-	0	-
Cold Plates	6	6.0	*	-	0	-
N2 Tanks	8	56.0	0	-	10.0	56.0
O2 Tanks	12	56.0	0	-	28.0	56.0
O2/N2 Cont. Panel	1	58.0	*	-	0	-
Cabin Fan Assy.	1	38.0	*	-	0	-
Regen. CO_2 Assy	1	67.0	1	67.0	0	-
Emerg. CO_2 Container	12	.5	0	-	0	-
Inter. Cir. Assy.	1	20.0	0	-	0	-
Odor Control	8	5.0	8	5.0	0	-
Cabin HX	1	43.0	*	-	2	43.0
Avionics Fan & HX	1	69.0	*	-	0	-
Catalytic Oxidizer	0	-	1	32.0	0	-

TABLE 6-1 EQUIPMENT LIST (Page 2 of 6)

*In Spacelab

MSP
FLIGHT HARDWARE DESCRIPTION

ELECTRICAL POWER	ADAPTER/AIRLOCK QTY	ADAPTER/AIRLOCK UNIT WT(LB)	HABITABILITY QTY	HABITABILITY UNIT WT(LB)	LOGISTICS QTY	LOGISTICS UNIT WT(LB)
Lights	13	3.5	13	3.5	4	3.5
Wiring	1	502.0	1	1103.0	2	19.0
30 VDC	1	58.0	1	58.0	0	-
Inverter	2	75.0	2	75.0	0	-
120 VDC Pwr Dist.	1	25.0	0	-	0	-
Pwr. Reg & Cont.	1	8.0	1	77.0	0	-

TABLE 6-1 EQUIPMENT LIST (Page 3 of 6)

MSP
FLIGHT HARDWARE DESCRIPTION

COMM. & DATA MGT	ADAPTER/AIRLOCK QTY	ADAPTER/AIRLOCK UNIT WT(LB)	HABITABILITY QTY	HABITABILITY UNIT WT(LB)	LOGISTICS QTY	LOGISTICS UNIT WT(LB)
I/O Unit	1	68.0	1	68.0	0	-
S/S RAU	2	17.0	2	17.0	2	5
Computer	2	68.0	2	68.0	0	-
DDU/KB	1	80.0	1	80.0	0	-
MMU	1	25.0	1	25.0	0	-
Printer	0	-	1	40.0	0	-
Experiment RAU	0	-	2	16.0	0	-
Intercom Remote Sta	3	2.0	3	2.0	2	2
Loud Speakers	1	2.0	1	2.0	2	2
EVA Comm. Set	1	30.0	0	-	0	-
Audio Sig. Proc.	1	20.0	0	-	0	-
Audio Tape Rec.	1	9.0	0	-	0	-
Intercom Master Sta.	0	-	1	22.0	0	-

TABLE 6-1 EQUIPMENT LIST (Page 4 of 6)

MSP
FLIGHT HARDWARE DESCRIPTION

COMM. & DATA MGT (Cont'd)	ADAPTER/AIRLOCK QTY	ADAPTER/AIRLOCK UNIT WT(LB)	HABITABILITY QTY	HABITABILITY UNIT WT(LB)	LOGISTICS QTY	LOGISTICS UNIT WT(LB)
Video Switching Unit	1	49.0	0	-	0	-
Video Processor	1	54.0	0	-	0	-
Video Data Stor.	1	108.0	0	-	0	-
Video Monitor	1	24.0	1	24.0	0	-
T.V. Camera - Int.	1	25.0	2	25.0	0	-
Camera Cont. Panel	0	-	1	10.0	0	-
Timing Dist. Unit	1	29.0	0	-	0	-
Timing Disp. Unit	1	5.0	1	5.0	0	-
C&W Dist. Assy	1	21.0	0	-	0	-
C&W Annunciator	1	15.0	1	15.0	0	-
C&W Processor	0	-	1	19.0	0	-
HRM	1	64.0	0	-	0	-
HDRR	1	108.0	0	-	0	-

TABLE 6-1 EQUIPMENT LIST (Page 5 of 6)

MSP
FLIGHT HARDWARE DESCRIPTION

CREW ACCOMMODATIONS	ADAPTER/AIRLOCK QTY	ADAPTER/AIRLOCK UNIT WT(LB)	HABITABILITY QTY	HABITABILITY UNIT WT(LB)	LOGISTICS QTY	LOGISTICS UNIT WT(LB)
Doors, Partitions, Etc.	1 Set	78.0	1 Set	300.0	0	-
Lighting	1	46.0	1	46.0	2	7.0
Hand/Sink Dryer	1	60.0	1	60.0	0	-
Urine Tank	1	25.0	1	25.0	0	-
Commode	2	145.0	0	-	0	-
Emerg. Waste Coll.	1	35.0	1	35.0	2	35.0
Lines, Valves, ETc.	1 Set	20.0	1 Set	20.0	2 Sets	20.0
Storage Cont.	1 Set	172.0	1 Set	296.0	2 Sets	186.0
Freezer	0	-	1	90 0	2	90.0
Refrigerator	0	-	1	72.0	0	-
Food Proc/Galley	0	-	1	166.0	0	-
Compactor	0	-	1	76.0	0	-
Cannister, Bags, Etc.	0	-	1 Set	169.0	0	-
Medical/Recreat.	0	-	1	100.0	2	100.0
Shower	1	90.0	0	-	0	-
IVA Masks	3	7.0	3	7.0	0	-
EVA Mobility Unit	3	175.0	0	-	0	-
Personal Rescue Spheres	0	-	3*	26.0	0	-

TABLE 6-1 EQUIPMENT LIST (Page 6 of 6)

*Assumed GFE; not included in estimated cost.

6.5 COST ESTIMATE

Table 6-2 presents the estimated costs for the Manned Space Platform. These costs are reported by the WBS categories defined in the WBS Dictionary presented in Section 2. The development cost is 50% of the total program cost. The recurring cost is 48% and the contractor support to the ground operations costs through launch and orbit injection with the full three module configurations is 2% of the total program cost. The ratio between development and recurring cost reflects the large amount of existing hardware that is used. If Spacelab hardware were not available, or if later technology were selected during future design studies, the nonrecurring costs could significantly increase.

The flight hardware and software engineering development is approximately 30% of the total development cost. The systems test is 54% of the development cost. The low engineering cost reflects the extensive use of existing equipment which includes not only the complete, intact Space Platform and Orbiter Airlock, but also subsystems from the Spacelab. The high ratio of system test costs reflects the need for hardware for the mockup and also the cost of integrating the total system and some additional testing of Spacelab to verify its longer life required by this program.

The flight hardware recurring cost is 80% of the total recurring program cost. This is a typical ratio with the programmatic portion being 25% of the flight hardware cost.

A summary of the technical characteristics which provides additional details regarding the methods of estimating is shown in Table 6-3.

TABLE 6-2
MSP COST ESTIMATE

WBS	TITLE	NONRECURRING	RECURRING	OPS	TOTAL
			(Millions of 1981 Dollars)		
0.0	GRAND TOTAL	$1015.94	$976.83	$32.89	$2025.67
1.0	PROJECT MGT.	48.39	46.51	1.57	96.46
2.0	SYSTEM ENGR. & INT.	87.05	63.98		151.03
3.0	MODULES	270.19	793.09		1063.27
3.1	SPACE PLATFORM		180.00		180.00
3.2	ADAPTER/AIRLOCK	57.51	135.07		192.58
3.2.1	INTEGRATION/FACO	4.26	19.45		23.71
3.2.2	STRUCTURE	31.25	16.79		48.04
3.2.3	ECLS	.74	12.85		13.59
3.2.4	ELECTRICAL POWER	1.90	19.02		20.93
3.2.5	COMM. & DATA MGT	13.23	52.90		66.13
3.2.7	CREW ACCOM	6.14	4.31		10.45
3.2.9	A/A SPARES		9.73		9.73
3.3	HABITABILITY EQPT.	86.90	259.85		346.75
3.3.1	INTEGRATION/FACO	6.44	39.97		46.41
3.3.2	STRUCTURE	26.37	42.64		69.01
3.3.3	ECLS	10.35	60.55		70.90
3.3.4	ELECTRIC POWER	7.42	19.04		26.46
3.3.5	COMM. & DATA MGT.	18.34	73.36		91.70
3.3.7	CREW ACCOM	17.98	4.30		22.28
3.3.9	HABIT. SPARES		19.99		19.99
3.4	LOGISTICS	46.02	218.17		264.19
3.4.1	INTEGRATION/FACO	3.41	33.56		36.97
3.4.2	STRUCTURE	41.62	144.36		185.98
3.4.3	ECLS		18.12		18.12
3.4.4	ELECTRIC POWER	.17	.15		.32
3.4.5	COMM. & DATA MGT.	.38	3.08		3.46
3.4.7	CREW ACCOM.	.43	2.12		2.56
3.4.9	LOGISTICS SPARES		16.78		16.78

TABLE 6-2
MSP COST ESTIMATE (Continued)

WBS	TITLE	NONRECURRING	RECURRING	OPS	TOTAL
		(Millions of 1981 Dollars)			
3.5	PAYLOAD OPTS	(Reference; not in baseline estimate)			0
3.6	SOFTWARE	31.10			31.10
3.7	COMMON	48.65	0		48.65
3.7.1	RECURRING		-9.68*		-9.68*
3.7.2	STRUCTURE	10.20	1.15		11.34
3.7.3	ECLS	20.06	6.16		26.22
3.7.4	ELECTRIC POWER	N/A	N/A	N/A	N/A
3.7.5	COMM. & DATA MGT.	13.37			13.37
3.7.7	CREW ACCOM.	5.03	2.37		7.40
4.0	SYSTEM TEST/EVAL.	547.46	73.25		620.71
4.1	MAJOR TEST ART.	440.33			440.33
4.2	MOD-MOD INT.	107.14	73.25		108.38
5.0	GROUND SPT. EQ.	52.84			52.84
6.0	FLIGHT SPT. EQ.	10.03			10.03
7.0	OPERATIONS			31.33	31.33

*Reference only; value included in individual module recurring costs.

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"

LEVEL AND PHASE*	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
10	1.0	Project Management	$96,460,322	Dollars	Factored
10	2.0	Syst. Engr. & Integ.	151,032,133	Dollars	Factored
11	3.0	Modules	270,189,371	Dollars	Summation
12	3.0	Modules	0	Dollars	Summation
15	3.0	Modules	746,585,928	Dollars	Summation
18	3.0	Modules	46,495,494	Dollars	Summation
21	3.1	Space Platform	0		
22	3.1	Space Platform	0		
25	3.1	Space Platform	180,000,000	Dollars	NASA Input
21	3.2	Adapter/Airlock	57,513,087	Dollars	Summation
25	3.2	Adapter/Airlock	125,340,779	Dollars	Summation
28	3.2	Adapter/Airlock	9,727,064	Dollars	Summation
31	3.2.1	Integration	4,260,288	Dollars	Factored
35	3.2.1	Integration/FACO	19,451,129	Dollars	Factored
31	3.2.2	Structure	31,248,814	Dollars	Summation
35	3.2.2	Structure	16,793,486	Dollars	Summation
41	3.2.2.1	Str-Primary	12,930,149	Dollars	CER/FACT
45	3.2.2.1	Str-Primary	5,467,279	Dollars	CER/FACT
41	3.2.2.2	Str-Secondary	18,318,665	Dollars	CER/FACT
45	3.2.2.2	Str-Secondary	2,686,208	Dollars	CER/FACT
45	3.2.2.3	Orb. Airlock	8,639,999	Dollars	Throughput
31	3.2.3	ECLS	738,227	Dollars	Summation

*Level and Phase:
First digit represents the program assembly level in decending order, i.e., "1" is the highest level.

Second digit represents the phase of the program:
0 - Total Program
1 - Design/Development Engineering
2 - Ground Test
5 - Production
8 - Spares

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"
(Continued)

LEVEL AND PHASE	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
35	3.2.3	ECLS	12,852,894	Dollars	Summation
41	3.2.3.1	Water Mgmt. System	0		
45	3.2.3.1	Water Mgmt. System	4,028,680	Dollars	Factored
41	3.2.3.2	Act. Therm. Control	0		
45	3.2.3.2	Act. Therm. Control	409,480	Dollars	Factored
41	3.2.3.3	Atms. Str. & Contl.	0		
45	3.2.3.3	Atms. Str. & Contl.	4,879,680	Dollars	Factored
41	3.2.3.4	ATM Revitalization	738,227	Dollars	Factored
45	3.2.3.4	ATM Revitalization	3,001,453	Dollars	Factored
41	3.2.3.5	Equipment Conditioning	0		
45	3.2.3.5	Equipment Conditioning	533,599	Dollars	Factored
31	3.2.4	Electric Power	1,902,283	Dollars	Factored
35	3.2.4	Electric Power	19,022,839	Dollars	Factored
31	3.2.5	Comm. & Data Mgmt.	13,266,150	Dollars	Factored
35	3.2.5	Comm. & Data Mgmt.	52,904,599	Dollars	Factored
31	3.2.7	Crew Accomm.	6,137,382	Dollars	Summation
35	3.2.7	Crew Accomm.	4,312,829	Dollars	Summation
41	3.2.7.1	Interior Furnishing	5,921,382	Pounds	CER
45	3.2.7.1	Interior Furnishing	367,637	Dollars	CER
41	3.2.7.2	Lighting	0		
45	3.2.7.2	Lighting	104,400	Dollars	Factored
41	3.2.7.3	Hygiene/Waste	0		
45	3.2.7.3	Hygiene/Waste	3,759,792	Dollars	Factored
38	3.2.9	A/A Spares	9,727,064	Dollars	Factored
21	3.3	Habitability Eqpt.	86,902,720	Dollars	Summation
25	3.3	Habitability Eqpt.	239,859,051	Dollars	Summation
28	3.3	Habitability Eqpt.	19,986,254	Dollars	Summation
31	3.3.1	Integration	6,437,238	Dollars	Factored
35	3.3.1	Integration/FACO	39,972,508	Dollars	Factored

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"
(Continued)

LEVEL AND PHASE	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
31	3.3.2	Structure	26,370,930	Dollars	Summation
35	3.3.2	Structure	42,642,243	Dollars	Summation
41	3.3.2.1	Str.-Primary	0		
45	3.3.2.1	Str.-Primary	788,965	Dollars	CER/FACT
41	3.3.2.2	Str.-Secondary	22,488,329	Dollars	CER/FACT
45	3.3.2.2	Str.-Secondary	3,027,274	Dollars	CER/FACT
41	3.3.2.3	Spacelab	3,882,600	Dollars	Factored
45	3.3.2.3	Spacelab	38,825,999	Dollars	Throughput
31	3.3.3	ECLS	10,350,679	Dollars	Summation
35	3.3.3	ECLS	60,551,349	Dollars	Summation
41	3.3.3.1	Water Mgmt.	0		In Spacelab
45	3.3.3.1	Water Mgmt.	0		In Spacelab
41	3.3.3.2	Act. Thermal Cnt.	0		In Spacelab
45	3.3.3.2	Act. Thermal Cnt.	0		In Spacelab
41	3.3.3.3	Atmos. Stor. & Cntl	0		In Spacelab
45	3.3.3.3	Atmos. Stor. & Cntl	0		In Spacelab
41	3.3.3.4	Atmos. Revitalization	4,407,999	Dollars	Factored
45	3.3.3.4	Atmos. Revitalization	1,124,550	Dollars	Factored
41	3.3.3.5	Equip. Conditioning	0		In Spacelab
45	3.3.3.5	Equip. Conditioning	0		In Spacelab
41	3.3.3.6	Spacelab	5,942,680	Dollars	Factored
45	3.3.3.6	Spacelab	59,426,799	Dollars	Throughput
31	3.3.4	Electric Power	7,424,110	Dollars	Factored
35	3.3.4	Electric Power	19,036,179	Dollars	Factored
31	3.3.5	Comm. & Data Mgmt.	18,339,964	Dollars	Factored
35	3.3.5	Comm. & Data Mgmt.	73,359,856	Dollars	Factored
31	3.3.7	Crew Accomod.	17,979,796	Dollars	Summation
35	3.3.7	Crew Accomod.	4,296,912	Dollars	Summation
41	3.3.7.1	Interior Furnishings	11,865,796	Pounds	CER

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"
(Continued)

LEVEL AND PHASE	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
45	3.3.7.1	Interior Furnishings	1,019,260	Pounds	CER
41	3.3.7.2	Lighting	0		
45	3.3.7.2	Lighting	78,300	Dollars	Factored
41	3.3.7.3	Hygiene/Waste	0		
45	3.3.7.3	Hygiene/Waste	878,351	Dollars	Factored
41	3.3.7.4	Food Mgmt.	4,059,999	Dollars	Throughput
45	3.3.7.4	Food Mgmt.	1,681,999	Dollars	Throughput
41	3.3.7.5	Trash Mgmt.	811,999	Dollars	Throughput
45	3.3.7.5	Trash Mgmt.	260,999	Dollars	Throughput
41	3.3.7.6	Storage Containers	161,999	Dollars	Throughput
45	3.3.7.6	Storage Containers	107,999	Dollars	Throughput
41	3.3.7.8	Medical/Recreational	1,079,999	Dollars	Throughput
45	3.3.7.8	Medical/Recreational	269,999	Dollars	Throughput
38	3.3.9	Spares	19,986,254	Dollars	Factored
21	3.4	Logistics	46,022,682	Dollars	Summation
25	3.4	Logistics	201,386,098	Dollars	Summation
28	3.4	Logistics	16,782,174	Dollars	Summation
31	3.4.1	Integration	3,409,087	Dollars	Factored
35	3.4.1	Integration/FACO	33,564,349	Dollars	Factored
31	3.4.2	Structure	41,623,225	Dollars	Summation
35	3.4.2	Structure	144,360,118	Dollars	Summation
41	3.4.2.1	Str.-Primary	13,243,013	Dollars	CER/FACT
45	3.4.2.1	Str.-Primary	5,238,863	Dollars	CER/FACT
41	3.4.2.2	Str.-Secondary	21,776,009	Dollars	CER/FACT
45	3.4.2.2	Str.-Secondary	7,037,350	Dollars	CER/FACT
41	3.4.2.3	Spacelab	6,604,200	Pounds	Factored
45	3.4.2.3	Spacelab	132,084,000	Pounds	Throughput
31	3.4.3	ECLS	0		
35	3.4.3	ECLS	18,115,720	Dollars	Summation

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"
(Continued)

LEVEL AND PHASE	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
41	3.4.3.1	Water Mgmt. System	0		
45	3.4.3.1	Water Mgmt. System	10,458,560	Dollars	Factored
41	3.4.3.3	Atmos. Str. & Contl.	0		
45	3.4.3.3	Atmos. STr. & Contl.	6,723,360	Dollars	Factored
41	3.4.3.4	Atmos. Revitalization	0		
45	3.4.3.4	Atmos. Revitalization	933,800	Dollars	Summation
31	3.4.4	Electric Power	173,884	Dollars	Summation
35	3.4.4	Electric Power	145,788	Dollars	Summation
41	3.4.4.1	Lights	104,400	Dollars	Factored
45	3.4.4.1	Lights	139,200	Dollars	Throughput
41	3.4.4.2	Wiring	69,483	Pounds	CER
45	3.4.4.2	Wiring	6,588	Pounds	CER
31	3.4.5	Comm. & Data Mgmt.	384,485	Dollars	Factored
35	3.4.5	Comm. & Data Mgmt.	3,075,882	Dollars	Throughput
31	3.4.7	Crew Accom.	431,999	Dollars	Summation
35	3.4.7	Crew Accom.	2,124,240	Dollars	Summation
41	3.4.7.2	Lighting	0		
45	3.4.7.2	Lighting	104,400	Dollars	Factored
41	3.4.7.3	Hygiene/Waste	0		
45	3.4.7.3	Hygiene/Waste	27,840	Dollars	Factored
41	3.4.7.4	Food Mgmt.	0		
45	3.4.7.4	Food Mgmt.	696,000	Dollars	Factored
41	3.4.7.6	Storage Containers	431,999	Dollars	Throughput
45	3.4.7.6	Storage Containers	216,000	Dollars	Throughput
41	3.4.7.8	Medical/Recreational	0		
45	3.4.7.8	Medical/Recreational	1,080,000	Dollars	Throughput
38	3.4.9	Logistics-Spares	16,782,174	Dollars	Factored
21	3.6	Software	31,099,507	Dollars	Throughput
25	3.6	Software	0		

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"
(Continued)

LEVEL AND PHASE	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
21	3.7	Common	48,651,373	Dollars	Summation
31	3.7.2	Structure	10,195,057	Dollars	Summation
41	3.7.2.1	Str.-Primary	9,957,578	Pounds	CER
41	3.7.2.2	Str.-Secondary	595,396	Pounds	CER
31	3.7.3	ECLS	20,058,752	Dollars	Summation
41	3.7.3.1	Water Mgmt. System	4,482,207	Dollars	Factored
41	3.7.3.2	Act Thermal Control	296,047	Dollars	Factored
41	3.7.3.3	Atmos. Stor. & Cntl.	3,242,010	Dollars	Factored
41	3.7.3.4	Atmos. Revitalization	6,793,850	Dollars	Factored
41	3.7.3.5	Equip. Conditioning	53,359	Dollars	Summation
41	3.7.3.7	Lines & Valves	5,191,276	Dollars	Factored
31	3.7.5	Comm. & Data Mgmt.	13,271,600	Dollars	Throughput
31	3.7.7	Crew Accom.	5,025,962	Dollars	Summation
41	3.7.7.2	Lighting	574,707	Dollars	Throughput
41	3.7.7.3	Hygiene/Waste	3,224,980	Dollars	Factored
41	3.7.7.4	Food Management	1,226,274	Dollars	Summation
11	4.0	System Test/Eval.	19,066,025	Dollars	Summation
12	4.0	System Test/Eval.	528,391,856	Dollars	Summation
15	4.0	System Test/Eval.	73,248,982	Dollars	Summation
22	4.1	Major Test Article	440,326,547	Dollars	Factored
21	4.2	Mod. - Mod. Int.	19,066,025	Dollars	Factored
22	4.2	Test/Labor Rework	88,065,309	Dollars	Factored
25	4.2	Mod. - Mod. Int.	66,048,982	Dollars	Factored
25	4.2	Power Platform Int.	7,199,999	Dollars	Factored
11	5.0	Ground Supt. Equip.	52,839,185	Dollars	Factored
11	6.0	Flight Supt. Equip	10,030,000	Dollars	Throughput

TABLE 6-3
TECHNICAL CHARACTERISTICS
DATA FORM "B"
(Continued)

LEVEL AND PHASE	WBS NUMBER	TITLE	TOTAL COST	UNITS OF MEASURE	CHARACTERISTICS
17	7.0	Operations	31,327,500	Dollars	Summation
27	7.1	Launch Spt./KSC Int.	29,700,000	Dollars	Throughput
27	7.2	Mission Ops. - Dev.	1,162,499	Dollars	Throughput
27	7.2	Mission Ops. - Rec.	464,999	Dollars	Throughput

6.6 FUNDING DISTRIBUTION

The funding distribution based on the schedule presented in Section 4 and the groundrules and assumptions in Subsection 6.1 is depicted in summary form in Table 6-4. A detailed listing of the annual funding requirements is presented in Tables 6-5 through 6-7.

TABLE 6-4
MSP FUNDING SUMMARY

	1986	1987	1988	1989	1990	Total
Constant (1981 Dollars)	77.3	401.2	968.2	541.7	37.2	2025.7
Real Year	127.0	722.4	1910.5	1170.5	88.2	4018.5

TITLE: EVOLUTIONARY SCIENCE AND APPLIC. MANNED SP. PLAT.

COST DATA FORM = D(1)
NON-RECURRING (DEVELOPMENT)

WBS NUMBER	WBS TITLE	CUM TOTAL	FISCAL YEARS (1981 DOLLARS IN MILLIONS) 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	TOTAL PROGRAM	2025.67	77.33	401.24	968.22	541.67	37.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	TOTAL DDT&E	1015.94	77.33	326.62	415.09	178.94	17.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	PROJECT MGT.	48.38	2.11	11.84	20.23	12.18	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
101	PROJECT MGT.	48.38	2.11	11.84	20.23	12.18	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	SYSTEM ENGR & INT.	87.05	.76	21.68	38.86	21.76	3.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	MODULES	270.19	64.53	161.48	44.06	.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	ADAPTER/AIRLOCK	57.51	15.06	35.51	6.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30201	INTEGRATION	4.26	1.12	2.63	.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30202	STRUCTURE	31.25	8.18	19.29	3.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30203	E C L S	.74	.19	.46	.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30204	ELECTRIC POWER	1.90	.50	1.17	.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30205	COMM. & DATA MGT.	13.23	3.46	8.17	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30207	CREW ACCOM.	6.14	1.61	3.79	.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
303	HABITABILITY EQPT.	86.90	22.76	53.65	10.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30301	INTEGRATION	6.44	1.69	3.97	.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30302	STRUCTURE	26.37	6.91	16.28	3.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30303	E C L S	10.35	2.71	6.39	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30304	ELECTRIC POWER	7.42	1.94	4.58	.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30305	COMM. & DATA MGT.	18.34	4.80	11.32	2.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30307	CREW ACCOM.	17.98	4.71	11.10	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
304	LOGISTICS	46.02	10.15	26.93	8.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30401	INTEGRATION	3.41	.75	1.99	.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30402	STRUCTURE	41.62	9.18	24.35	8.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30404	ELECTRIC POWER	.17	.04	.10	.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30405	COMM. & DATA MGT.	.38	.08	.22	.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30407	CREW ACCOM.	.43	.10	.25	.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
306	SOFTWARE	31.10	5.84	16.93	8.22	.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
307	COMMON	48.65	10.73	28.47	9.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30702	STRUCTURE	10.20	2.25	5.97	1.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30703	E C L S	20.06	4.42	11.74	3.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30705	COMM. & DATA MGT.	13.37	2.95	7.82	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30707	CREW ACCOM.	5.03	1.11	2.94	.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	SYSTEM TEST/EVAL.	547.46	0.00	102.86	297.96	144.70	1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
401	MAJOR TEST ART.	440.33	0.00	82.73	239.65	116.39	1.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00
402	MOD-MOD INT	107.13	0.00	20.13	58.31	28.32	.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	GRND SUPT. EQPT.	52.84	9.93	28.76	13.97	.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	FLIGHT SUPT. EQPT.	10.03	0.00	0.00	0.00	0.00	10.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 6-5
FUNDING SUMMARY
NONRECURRING

TITLE: EVOLUTIONARY SCIENCE AND APPLIC. MANNED SP. PLAT.

COST DATA FORM = D(2)
RECURRING (PRODUCTION)

WBS NUMBER	WBS TITLE	CUM TOTAL	FISCAL YEARS (1981 DOLLARS IN MILLIONS) 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	TOTAL PRODUCTION	976.83	0.00	70.92	541.37	350.46	14.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	PROJECT MGT.	46.52	0.00	2.47	19.94	21.75	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
101	PROJECT MGT.	46.52	0.00	2.47	19.94	21.75	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	SYSTEM ENGR & INT.	63.98	0.00	3.90	31.48	26.14	2.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	MODULES	793.08	0.00	64.55	489.95	229.75	8.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00
301	SPACE PLATFORM	180.00	0.00	16.71	115.84	47.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	ADAPTER/AIRLOCK	135.07	0.00	12.13	91.89	31.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30201	INTEGRATION	19.45	0.00	0.00	16.40	3.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30202	STRUCTURE	16.79	0.00	1.92	11.97	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30203	E C L S	12.85	0.00	1.47	9.16	2.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30204	ELECTRIC POWER	19.02	0.00	2.18	13.56	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30205	COMM. & DATA MGT.	52.90	0.00	6.06	37.72	9.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30207	CREW ACCOM.	4.31	0.00	.49	3.07	.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30209	A/A SPARES	9.73	0.00	0.00	0.00	9.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
303	HABITABILITY EQPT.	259.85	0.00	22.89	176.20	60.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30301	INTEGRATION	39.97	0.00	0.00	33.69	6.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30302	STRUCTURE	42.64	0.00	4.88	30.40	7.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30303	E C L S	60.55	0.00	6.94	43.17	10.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30304	ELECTRIC POWER	19.04	0.00	2.18	13.57	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30305	COMM. & DATA MGT.	73.36	0.00	8.40	52.30	12.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30307	CREW ACCOM.	4.30	0.00	.49	3.06	.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30309	HABIT SPARES	19.99	0.00	0.00	0.00	19.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
304	LOGISTICS	218.17	0.00	12.12	108.83	88.49	8.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30401	INTEGRATION	33.56	0.00	0.00	16.03	17.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30402	STRUCTURE	144.36	0.00	10.43	79.82	52.62	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30403	E C L S	18.12	0.00	1.31	10.02	6.60	.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30404	ELECTRIC POWER	.15	0.00	.01	.08	.05	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30405	COMM. & DATA MGT.	3.08	0.00	.22	1.70	1.12	.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30407	CREW ACCOM.	2.12	0.00	.15	1.17	.77	.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30409	LOGISTICS SPARES	16.78	0.00	0.00	0.00	9.79	6.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
307	COMMON	.00	0.00	.70	-2.81	2.01	.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30701	INTEG/FACO	-9.68	0.00	0.00	-8.16	-1.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30702	STRUCTURE	1.15	0.00	.08	.63	.42	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30703	E C L S	6.16	0.00	.45	3.41	2.25	.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30707	CREW ACCOM.	2.37	0.00	.17	1.31	.87	.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	SYSTEM TEST/EVAL.	73.25	0.00	0.00	0.00	72.81	.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
402	MOD-MOD INT	73.25	0.00	0.00	0.00	72.81	.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	FLIGHT SUPT. EQPT.	.00	0.00	0.00	0.00	0.00	.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6-6

FUNDING SUMMARY, RECURRING PRODUCTION

TITLE: EVOLUTIONARY SCIENCE AND APPLIC. MANNED SP. PLAT.

COST DATA FORM = D(3)
RECURRING (OPERATIONS)

WBS NUMBER	WBS TITLE	CUM TOTAL	FISCAL YEARS (1981 DOLLARS IN MILLIONS) 1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	TOTAL OPERATION	32.89	0.00	3.70	11.76	12.27	5.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	PROJECT MGT.	1.57	0.00	.10	.77	.64	.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
101	PROJECT MGT.	1.57	0.00	.10	.77	.64	.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	OPERATIONS	31.33	0.00	3.60	10.99	11.63	5.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
701	LAUNCH SPT/KSC INT	29.70	0.00	3.60	10.80	10.80	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
702	MISSION OPS-DEV	1.63	0.00	0.00	.19	.83	.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6-7

FUNDING SUMMARY, RECURRING OPERATIONS

APPENDIX A

REFERENCES

The following documents were used in developing the conclusions set forth in Section 5, Environmental Analysis:

1. Implementing the Provisions of the National Environmental Policy Act, NHB 8800.11, NASA, 1980.
2. Power System Platform Environmental Assessment, MDAC Report MDC G9324A, May 1981.
3. Environmental Impact Statement, Space Shuttle Program, April 1980.
4. Evolutionary Science and Applications Platform, Second Interim Briefing, MDAC Report MDC G9744, November 1981.
5. Evolutionary Science and opplications Platform, Study Plan, MDAC Report MDC G9378.
6. Environmental Assessment Document Alternate System Design Concept Study, MDAC Report MDC G9324, December 1980.

End of Document